

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1936

STAFF CHANGES have been as follows. Professor Oakes Ames, Supervisor, having requested to be relieved of his multifarious administrative duties, was appointed by the University as Research Professor of Botany. He continued as Supervisor of the Arnold Arboretum until October 17, 1935 when I took over his duties as Acting Supervisor in addition to my general task as Administrator of Botanical Collections of Harvard University. The position of Administrator of Botanical Collections was created to further the task of coördination of the botanical activities, so admirably developed by Professor Ames, of the eight separately endowed units of Harvard University. These units are the Botanic Garden, the Gray Herbarium, the Botanical Museum, the Farlow Library and Herbarium in Cambridge, the Arnold Arboretum and the Bussey Institution in Jamaica Plain, the Harvard Forest at Petersham, and the Atkins Institution of the Arnold Arboretum at Soledad, Cienfuegos, Cuba.

Professor John George Jack became Assistant Professor of Dendrology, Emeritus, at the close of last year, while Dr. Donald Wyman was appointed as Horticulturist, effective January 1, 1936, succeeding Dr. Edgar Anderson, Arborist, who resigned at the end of the year to accept an appointment at Washington University, St. Louis. Associate Professor Karl Sax was promoted to full Professorship.

The Arboretum has continued to receive current gifts in support of its work from various interested individuals, while some additions have been made to the endowment. Perhaps the most important single gift was the Butler estate adjoining the Arboretum on Centre Street side. This was bequeathed to the Arboretum by Miss Isabel Butler and became available May 15th. It adds about 1½ acres to the Arboretum lands, and makes available one more dwelling house which has been designated as the official residence of the Supervisor.

Buildings and Grounds.—The winter of 1935–36 was much milder than the two preceding years. Although fairly low temperatures prevailed at times, no severe cold was experienced until after the middle of February, the lowest temperature of the winter being 13° below on February thirtieth. Light snow fell occasionally up to January nine-

teenth when the first heavy fall of snow, measuring one foot, occurred. This snowfall remained on the ground for several weeks, giving adequate protection to low-growing plants. Although the rainfall was very light from August to December there was no great injury to the plants from this cause. This limited rainfall was compensated by the snow in January, which was equivalent to over 8 inches of rain. Early spring rains were heavy in March and April, thus supplying sufficient moisture for general needs. Winter damage to trees and shrubs was no greater than during an average winter.

During the year, 1390 packages of seed were distributed, 1025 in the United States, 361 to 15 foreign countries; scions and cuttings of 899 species and varieties were supplied to institutions and individuals. There were received from various sources 334 packages of seed, 1351 living plants, and 121 cuttings and scions. Seven hundred and eighty-nine plants were added to various collections in the Arboretum.

Normal repairs to buildings were made as needed, and in the grounds various trees past their prime were removed. A vigorous spraying campaign was prosecuted to combat various insect pests and plant diseases.

Through the coöperation of the Park Department of the City of Boston, 300 feet of new wire fence was installed along the Nervine border to replace obsolete sections, and the fencing on both sides of the Jamaica Plain entrance, 150 feet, was completed, a much needed improvement. All boundary fences were painted. Roads, paths and benches were repaired and much attention was given to the problem of draining the bog opposite the Administration Building.

Pathological Laboratory.—The policy of exerting all possible efforts in furtherance of the campaign to stamp out the Dutch elm disease from the United States has been continued. Indications point to a successful issue of the campaign if prosecuted as now projected. Our efforts have comprised: — (1) Extension laboratory service; (2) Co-operation with other agencies animated by the same motives; (3) Direct pleas to the Federal government urging adequate appropriations; (4) Publication of the viewpoint of the Arboretum on the subject in a separate issue of its "Bulletin"; (5) Maintenance of a field laboratory on Long Island, N. Y.; (6) Researches on native wilt diseases of elms.

As matters of routine the laboratory has responded to a large number of inquiries on the diseases of many kinds of trees and shrubs, further developed its herbarium and reference collections and contributed a course at Harvard College on the pathology of woody plants.

Among the year's published results of investigations conducted by the laboratory special mention should be made of the following: (1) A preliminary paper by D. B. Creager throws light on the etiology and means of control of "Cephalosporium wilt disease" of elms. This disease is frequent and in some regions abundant from Minnesota to Maine and southward. Not only does it occur in established plantings but it has been and is unwittingly distributed from some nurseries because of existing lack of understanding of its nature and importance. (2) A paper by Dr. L. M. Hunter, monographic in scope, presents for the first time a detailed, systematic account of the morphology and the ontogeny of the spermogonia of the rust fungi that attack conifers. It is an admirable contribution to descriptive taxonomy; it also shows how certain species and genera can be distinguished from one another on their coniferous hosts alone — something that heretofore has often not been possible. (3) Three other papers, from Drs. J. H. Faull, I. H. Crowell, J. D. MacLachlan, respectively, materially extend our knowledge of the biology and the control of rusts of coniferous and pomaceous plants. One paper, dealing with two spruce rusts long known on their angiospermous hosts only, records experimental data showing that they alternate on spruces. The remaining two are significant, contributing as they do to a comprehensive understanding of Gymnosporangium rusts that alternate between Juniperus and pomaceous hosts and demonstrating practical means of control without having to resort to elimination of the alternate hosts.

Of the several researches that have been in progress, mention should be made of Dr. J. D. MacLachlan's work on a devastating disease of certain Myrtaceae, particularly pimento, the experimental part of which was carried out in Jamaica under the tenure of a Sheldon fellowship and in coöperation with the Jamaican government. He has solved the problem and showed that temperature is the decisive factor governing the spread of the disease. It is now clear that this crop asset, supposedly lost, can be perpetuated by establishing plantations at warmer levels (below approximately 1500 to 2000 feet altitude). Moreover, MacLachlan's findings with regard to the temperature factor call attention to a feature which probably influences the development of many other rust species.

The work of the laboratory has received generous recognition and support from various quarters. One result is a stimulus to effort. Another is provision for investigations otherwise not possible. Financial help, which is deeply appreciated, has come from the North Country Garden Club of Long Island, Mrs. Harold I. Pratt, the Massa-

chusetts Society for Promoting Agriculture, and the Noanett Garden Club.

Cytogenetic Laboratory.—The work on cytotaxonomic problems during the past year includes an analysis of American species of *Iris* by Dr. R. C. Foster, additional work on the Gymnosperms by Dr. Walter S. Flory, and an analysis of triploid varieties of *Malus* by Dr. Haig Dermen, and a study of polyploidy and geographic distribution in *Spiraea*.

Considerable work has been done on the experimental production of polyploidy. Extreme temperature variations produce chromosome doubling in the male gametes of *Rhoeo* and *Tradescantia*. Experiments involving the fertilized egg cells are in progress. Polyploid plants frequently are more vigorous and hardy than diploids, and the experimental production of polyploids may be of considerable practical value.

Work on chromosome structure in relation to meiosis and genetics has been continued. Dr. J. G. O'Mara has found that major coils in meiotic chromosomes can be suppressed by temperature treatment, and that these major coils are not a factor in chiasma formation. Relational coiling has been studied by Dr. L. Husted, who has used X-Ray-induced ring chromosomes for his analysis. The relational coiling in *Trillium* and *Vicia* has been studied finding that the direction of relational coiling is approximately at random for homologous chromosomes. This analysis is of interest in relation to the mechanism of crossing over. An analysis of chromosome behavior in relation to crossing over was presented at the 6th International Botanical Congress at Amsterdam.

The breeding work with ornamental shrubs has resulted in a number of hybrids which flowered this year. Many of the hybrids were made between American and Asiatic species, and these should be of value in a study of factors in speciation. Some of the hybrids should be of horticultural value.

The Herbarium.—During the past fiscal year 21363 specimens were distributed into the herbarium, bringing up the total to 430,062 mounted sheets. Of these accessions 6575 came from China, 5134 from Central and South America including Mexico, 2538 from Malaysia and India, 2167 from Australasia and 1330 from Africa.

Among the more important collections received during the last fiscal year may be mentioned 6647 specimens (including duplicates) from Hainan and Kwangtung, 3320 from Kwangsi and 1712 specimens from

Hunan, received from Lingnan University; about 10,000 numbers collected in Yunnan by H. C. Tsai, received from the Fan Memorial Institute; about 3000 numbers with many duplicates from Hainan, received from Sun Yatsen University; about 700 numbers with 5000 duplicates from Hunan received from the University of Nanking; 1280 numbers from Mexico collected by C. H. Mueller; 1369 numbers from Brazil collected by B. A. Krukoff; over 500 numbers of Brazilian plants collected by Riedel from 1831 to 1834, received from the Botanic Garden at Leningrad; 348 numbers from South America collected by Y. Mexia; over 200 numbers from Costa Rica collected by Alexander Skutch; 2095 numbers from Java and other Malayan islands received from the Botanic Garden at Buitenzorg; about 300 numbers of Malayan plants received from the Botanic Garden at Singapore; over 2000 Formosan plants collected by U. Faurie presented by Professor Oakes Ames; about 200 numbers from Central Asia received from the University at Taschkent; 510 numbers of European willows received from the Naturhistoriska Riksmuseet in Stockholm.

The fruit collection now contains 8432 specimens, 53 having been added during the year. Additions to the wood collection numbered 105 specimens bringing the total up to 3891.

The collection of photographic negatives of types and critical specimens, chiefly Chinese, now amounts to 3312 numbers, 300 having been added during the year. An alphabetical list of these has been prepared which will be sent on application to institutions desiring to exchange or to purchase prints.

During the year 2376 duplicates were distributed on our general exchange accounts and 1362 mounted sheets were loaned to specialists in Europe, America, and Asia for critical study.

Besides the constant use of the herbarium by members of the staff and also of other departments of the University for determination of plants sent in for identification, and of large collections chiefly from eastern Asia, the facilities of the herbarium have been used by visitors, among whom may be mentioned: Dr. N. C. Fassett, University of Wisconsin, Professor H. W. Rickett, University of Missouri, Professor Marie-Victorin, University of Montreal, Miss Alice Eastwood, California Academy of Science, Professor Wayne E. Manning, Smith College, Northampton, Mass., Dr. Clement G. Bowers, Maine, New York, Mr. F. Kingdon Ward, Cleve, England, and Mr. Paul Russell of the U. S. Department of Agriculture, Washington. Dr. Lawrence Ames of the U. S. Department of Agriculture, Washington has been provided with working quarters throughout the year.

Members of the staff have been engaged in work on special subjects. Dr. E. D. Merrill has identified various large collections from southeastern China. Professor A. Rehder has identified several collections from the Kwangsi province and has continued his study of the ligneous Lévillé plants from eastern Asia. Dr. I. M. Johnston has continued his study of Boraginaceae and his identification of a large collection of plants from Chile; he also has written an account of South American species of *Astragalus*. Dr. H. M. Raup has worked up his collections made in the Athabaska–Great Slave Lake region, of which an account is being published in this Journal. Dr. C. E. Kobuski is continuing his study on the genus *Eurya* and Dr. Caroline K. Allen her work on the Chinese Lauraceae. Mrs. S. D. McKelvey has practically finished a monographic study of one group of *Yucca*. Mr. E. J. Palmer is continuing his revision of the American species of *Crataegus*.

Dr. Raup spent the entire summer of 1935 collecting in the Athabaska Lake district of northern Canada, and studying the distribution of types of vegetation in that region. The expense of this work was met in large part by a grant from the Milton Fund. About 1120 numbers of vascular plants were collected, averaging about 4½ specimens to the number. In addition, about 60 numbers of fungi and about 40 of seeds were gathered, and a large collection of lichens and mosses was made. He devoted most of the winter to the determination and study of these collections, and to the preparation of the first half of a catalogue of the flora of the Athabaska–Great Slave Lake region. In this catalogue 11 new species and varieties are described, most of them collected during the 1935 explorations. His study of local climatic conditions in the Arboretum was continued throughout the winter. This consisted mainly in taking temperature records each day at three localities selected as being the most significant of those studied during the previous year.

In September 1935, Professor A. Rehder attended the International Botanical Congress at Amsterdam and took the opportunity to visit the herbaria at Edinburgh, Kew, Paris, Berlin, Leiden and Utrecht, bringing back photographs of types of about 230 plants, mostly Chinese.

Botanical exploration, partly financed by the Arnold Arboretum has been prosecuted in Mexico and in China. Mr. C. H. Mueller again visited the Sierra Madre Oriental, in northeastern Mexico, as mentioned in last year's report and returned in August with a collection of about 450 numbers. The expedition, under Mr. C. H. Wang, sent out by Professor H. H. Hu from the Fan Memorial Institute to Yunnan, partly to regions not touched by Handel-Mazzetti or Forrest, collected

about 8,000 specimens. Lingnan University had several collectors working under the direction of Dr. F. P. Metcalf in the Kwangtung province, who gathered about 10,000 specimens. An expedition of the University of Nanking, under the direction of Dr. A. N. Steward, collected during the summer and autumn about 700 numbers in Hunan.

Following the plan developed at the New York Botanical Garden, a start has been made in inserting clipped or typed original descriptions, critical notes, illustrations, etc. in the herbarium, pasting them on the outside of the specimen covers. This will eventually entail a general reorganization of the herbarium and a universal use of the specimen covers which were formerly not used at all. Descriptions appertaining to non-woody plants are transmitted to the Gray Herbarium. In acquiring material for the herbarium, a working arrangement has been made with the Gray Herbarium, whereby one institution will not subscribe to a set of plants that the other has ordered, this plan in general favoring the Gray Herbarium for American material and the Arnold Arboretum for Eurasian collections. The actual transfer of reference collections on permanent deposit as between the two institutions has been discussed, but until additional storage space becomes available in both units, no extensive consummation of such a plan is possible.

The Library.—The total number of publications is now 42,547 bound volumes, 11,476 pamphlets, and 17,762 photographs, 522 bound volumes, 559 pamphlets and 179 photographs having been added during the year. A total of 10,023 cards were prepared and distributed into the various indices, while 2815 slips were filed in the supplement to the author and subject catalogue to the library, making 22,805 ready for publication. Professor Oakes Ames presented 100 colored lantern slides, and through the generosity of Mrs. Louis A. Frothingham, Dr. Wyman was able to add 250 more, thus providing important facilities for members of the staff.

Forty-three new periodicals were added to the list of those currently received, these additions acquired chiefly by exchange, a few by gift; most of these are new ventures in the publication field having been commenced, for the most part, since 1930. Through the courtesy of Dr. R. Kanehira, we were fortunately able to acquire a complete set of the *Journal of Japanese Botany*, the early volumes of which are out of print and very difficult to secure. A number of important independently published volumes were acquired by purchase, exchange, and gift, thus adding to the resources of the library.

The library continues to attract seekers for information, 425 having

registered during the year. The policy of sending out inter-library loans has been continued, as this is advantageous to individuals living at a distance as well as to our own staff members who occasionally have need to consult works that are not represented in any of the libraries in or near Boston, which through the inter-library loan system we are often able to borrow for limited periods. When books could not be loaned, we have supplied typewritten excerpts or photostat copies.

To facilitate work in the herbarium and to save time of staff members, shelves were constructed at the ends of the herbarium cases on all the floors of the main herbarium and about 800 constantly used volumes were transferred to this new location thus relieving to a considerable extent the overcrowded shelves in a part of the library proper.

During the year, the usual numbers of the Journal and of the Bulletin of Popular Information were issued as well as one number of the Contributions.

Atkins Institution of the Arnold Arboretum, Soledad, Cienfuegos, Cuba. Mr. Robert M. Grey who since 1899 has constantly been associated with the plantings at Soledad, retired on June 1, 1936 the University granting him the title Superintendent, Emeritus. Mr. Grey, originally employed by Mr. Atkins to direct sugar cane breeding work, was unusually well qualified by training, experience, and inclinations to develop the planting program at Soledad. To his continuous and efficient efforts over a period of 36 years we are largely indebted for the present extensive gardens and for the comprehensive collections of tropical plants now growing at the Atkins Institution. His record of achievement was a remarkable one both in the field of plant breeding and in that of the introduction and establishment of exotic species. In 1933 the published list of species grown at Soledad approximated 1970 species. Additions from 1933 to 1935 through the combined efforts of Mr. Grey, Mr. Walsingham and other interested parties approximate 2470 species and varieties.

On the termination of Mr. Grey's long term of service we were particularly fortunate in securing as his successor the services of Mr. David Sturrock, who was appointed Superintendent in June, 1936. He is a widely experienced plantsman with 12 years actual experience as a resident of Cuba. Under his leadership it is confidently expected that rapid development and a further expansion of the already extensive plantings at Soledad will result.

The total rainfall at Soledad during the year was 55.73 inches, somewhat above the annual average. This was reasonably well distributed,

the plantings not suffering appreciably from drought at any time. While the weather conditions were generally conducive to normal growth, unfortunately cyclonic winds proved to be destructive on three occasions, July 26, Sept. 3, and Sept. 27-28, 1935. The first two storms were of minor importance but the last was the most disastrous hurricane ever recorded at Soledad. Its results were extremely devastating. The high winds with a velocity of from 80 to 90 miles per hour, or at times even higher, continued for over five hours. The lowest barometer pressure was 28.48 inches at 3 A. M. Sept. 28.

Surprisingly little rain accompanied this storm. Many of the fine old trees were uprooted or badly broken, and with few exceptions all were denuded of their foliage. Many large palms were blown down or their tops were snapped off. In the injured trees it was observed that, in due time, some sprouted vigorously from near the base while the upper parts died or produced only a stunted growth. On the south side of many trees the bark appeared as though it had been burned into the cambium layers; this later caused the death of several species.

After the storm 72 cords of heavy wood and over 200 ox-cart loads of fallen branches and other débris were removed, this giving some graphic idea of the wreckage and the extra labor required to bring the garden into a somewhat presentable condition following the storm. A generous donation from Mrs. Atkins and the transfer of a similar amount from Arboretum funds provided the means by which the rehabilitation work could proceed without delay.

Following the storm necessary repairs were made to Harvard House and other structures. New construction includes the new seboruco dam and bridge, and a new road along the west bank of the arroyo below the cycad collections. The boundary fences have been repaired and small extensions made to the water distributing system. Much time had to be devoted to relabeling the arboretum specimens as over 200 labels were lost during the hurricane and others were in poor condition. The improved labels now used are much more satisfactory than the old ones being more durable and more economical than those formerly used.

Large additions were made to the succulent collections, chiefly through the Harvard Botanic Garden, the N. Y. Botanical Garden, and La Mortola Garden in Italy. The orchid collections have received extensive additions, particularly those sent by Mr. C. H. Lankester from Costa Rica, about 350 species now being represented. The rock garden has been increased to twice its former size. The lily, amaryllis, and ginger collections were transferred to a better location.

The seed and plant exchange program has been continued. Over 650

living plants, including 246 orchids, 95 cuttings, and 345 packets of seeds were received from various institutions and individuals thus adding many new and valuable species to the living collections. Large collections of living plants, bud wood, and cuttings, as well as 471 packets of seeds were distributed in connection with the general exchanges of such material.

Over 250 species represented by about 750 specimens were labeled, hardened up out of doors, and planted in various parts of the arboretum. The spring plantings were commenced April 17, following the first heavy rains, and completed on May 25.

In general, in addition to the heavy rehabilitation burden entailed by the destructive hurricane of Sept. 27–28, routine garden work such as cleaning, weeding, mowing, pruning, the eradication of diseases and insect pests, watering when necessary, and other incidentals have been given the usual attention.

Professor Thomas Barbour, Custodian, as usual spent several weeks at Soledad in February, arranging for the necessary repairs to Harvard House and conferring with Mr. Grey as to which damaged trees should be removed entirely and what should be pruned and allowed to rehabilitate themselves, and going over the collections at Harvard House to be sure of their freedom from pests, and to check their general condition after the storm. He is also publishing a report on the destruction of birds by the storm.

During the year Dr. Philip Darlington continued entomological studies which he had begun on previous visits. Professor J. H. Faull spent several weeks studying fungous diseases of the pimento tree and allies. Messrs. R. H. Goodwin and A. L. de Lisle, both graduate students, visited the Garden on University Fellowships to gather material for study in Cambridge. Dr. A. G. Kevorkian spent some time studying aquatic fungi and had the experience of being at the Laboratory during the great storm.

During the fiscal year 1935–36 grants or fellowships have been awarded to six students whose work at the Garden will be noticed next year.

Bibliography of the published writings of the staff and students July 1, 1935—June 30, 1936

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